

## CLAIMS

1. A component placing head (100) having a plurality of component holding members (11) for releasably holding components (1) which members are arranged in a row, and being capable of placing on a circuit board the plurality of components held by the component holding members, the component placing head comprising:

a first component image-pickup unit (20) capable of capturing images of the components held by the component holding members from a direction along central axes of the component holding members;

a second component image-pickup unit (30) capable of capturing images of the components held by the component holding members from a direction generally orthogonal to the central axes of the component holding members and to a direction of the arrangement of the component holding members;

supporting members (24, 25, 26) for supporting the first component image-pickup unit and the second component image-pickup unit so as to allow movement thereof in the direction of the arrangement of the component holding members;

a moving device (27) for moving the first component image-pickup unit and the second component image-

pickup unit in the direction of the arrangement of the component holding members between the component holding members arranged at both ends of the row; and

5 a control unit (9) that causes the first component image-pickup unit and the second component image-pickup unit to sequentially capture the images of the components held by the component holding members while moving the first component image-pickup unit and the second component image-pickup unit by the moving device in the  
10 direction of the arrangement of the component holding members and that is capable of recognizing holding postures of the components on the component holding members on basis of the images of the components captured by the first component image-pickup unit and the images of the  
15 components captured by the second component image-pickup unit,

wherein the components can be placed on the circuit board on basis of the holding postures of the components recognized by the control unit.

20 2. A component placing head (300) having a plurality of component holding members (11) for releasably holding components (1) which members are arranged in a row, and being capable of placing on a circuit board the plurality of components held by the component holding members, the  
25 component placing head having:

a first component image-pickup unit (320) having a plurality of image-pickup elements (323) capable of capturing images of the components held by the component holding members from a direction along central axes of the component holding members, in one-to-one correspondence to the component holding members and with positional relations fixed among the image-pickup elements, and having reflectors (321, 322) that are positioned on a central axis of a component holding member so as to reflect an image of the component held by the component holding member from the direction along the central axes and so as to make the image incident along an optical axis of a corresponding image-pickup element on the image-pickup element;

a second component image-pickup unit (30) capable of capturing images of the components held by the component holding members from a direction generally orthogonal to the central axes of the component holding members and to a direction of the arrangement of the component holding members;

a supporting member (324) for supporting the reflectors of the first component image-pickup unit and the second component image-pickup unit so as to allow movement thereof in the direction of the arrangement of the component holding members;

a moving device (27) for moving the reflectors

and the second component image-pickup unit in the direction of the arrangement of the component holding members between the component holding members arranged at both ends of the row; and

5           a control unit (9) that causes the image-pickup elements to sequentially capture the images of the components held by the corresponding component holding members, through the reflectors, and causes the second component image-pickup unit to sequentially capture the  
10   images of the components held by the component holding members while moving the reflectors and the second component image-pickup unit by the moving device in the direction of the arrangement, and that is capable of recognizing holding postures of the components on the  
15   component holding members on basis of the images of the components captured by the first component image-pickup unit and the images of the components captured by the second component image-pickup unit,

          wherein the components can be placed on the  
20   circuit boards on basis of the holding postures of the components recognized by the control unit.

3.       A component placing head as defined in claim 1,

          wherein the control unit is capable of recognizing holding postures of the components on the  
25   component holding members with respect to directions

generally orthogonal to the central axes of the component holding members on basis of the images captured by the first component image-pickup unit, and

wherein the control unit is capable of recognizing holding postures of the components on the component holding members, with respect to the direction along the central axes of the component holding members on basis of the images captured by the second component image-pickup unit.

4. A component placing head as defined in claim 3,

wherein the second component image-pickup unit is a line sensor (33) having a phototransmitter (31) and a photoreceiver (32) that are arranged so as to face each other with interposition of the component holding members arranged in the row and being capable of capturing an image of a component by reception, on the photoreceiver, of light cast from the phototransmitter toward the component held by the component holding member with a portion of the light interrupted by the component, and

wherein the control unit is operable to recognize a holding posture of the component with respect to the direction along the central axes on basis of capture result information obtained from the line sensor, detect a position of the line sensor moved by the moving device along the direction of the arrangement of the component

holding members, with the image capture, and identify the component of which the holding posture has been recognized, from among the components on basis of a result of the detection.

5 5. A component placing head as defined in claim 1,  
wherein the moving device has a drive motor (28)  
for moving the first component image-pickup unit in the  
direction of the arrangement of the component holding  
members, and

10 wherein the drive motor is provided so as to be  
opposed to the first component image-pickup unit with the  
component holding members between.

6. A component placing head as defined in claim 5,  
wherein the drive motor is provided so as to be opposed to  
15 the second component image-pickup unit also with the  
component holding members between.

7. A component placing head as defined in claim 1,  
wherein the first component image-pickup unit has:

20 image-pickup element (23, 323) that use as  
optical axes (T) thereof axes different from the central  
axes (S) of the component holding members and that are  
capable of capturing images of the components held by the  
component holding members incident along the optical axes;

25 reflectors (21, 22, 321, 322) for reflecting an  
image of a component from the direction along the central

axis of the component holding member, and thereby making the image incident along the optical axis of an image-pickup element on the image-pickup element;

horizontal light casting unit (61) for casting  
5 rays of light in generally horizontal directions directly onto a component imaging plane (Q) which is orthogonal to the central axis of the component holding member and in which the image of the component to be captured is obtained;

10 a vertical light casting unit (60) for casting rays of light generally along the optical axis, causing the rays of light to be reflected by the reflectors and to travel in the direction along the central axis, and casting the rays of light in generally vertical directions onto the  
15 component imaging plane; and

inclined light casting unit (62) for casting rays of light inclined at a generally medial angle between the horizontal directions and the vertical directions, directly onto the component imaging plane, and

20 wherein the control unit causes the image-pickup element to capture the image of the component in a status in which the horizontal light casting unit, the vertical light casting unit, and the inclined light casting unit are simultaneously casting the rays of light onto the component  
25 imaging plane of the component held by the component

holding member.

8. A component placing head as defined in claim 7, wherein the inclined light casting unit has a plurality of illuminating sections (62a) for inclined light that are arranged so as to be symmetric and opposed to each other with respect to the central axis of the component holding member as an axis of symmetry,

wherein the horizontal light casting unit has a plurality of illuminating sections (61a) for horizontal light that are arranged so as to be symmetric and opposed to each other with respect to the central axis of the component holding member as an axis of symmetry, and

wherein the illuminating sections are arranged in vicinity of a periphery of a zone (U) in which the rays of light in the generally vertical directions from the vertical light casting unit pass and which is formed on and around the central axis of the component holding member.

9. A component placing head as defined in claim 8, wherein the inclined light casting unit has two pairs of the illuminating sections (62a) for inclined light,

wherein the horizontal light casting unit has two pairs of the illuminating sections (61a) for horizontal light, and

wherein the illuminating sections for inclined light and the illuminating sections for horizontal light



are alternately positioned with an angle pitch generally of 45 degrees on a plane extending along the component imaging plane of the component.

10. A component placing head as defined in claim 7,  
5 wherein the vertical light casting unit has a shade plate (28) that is provided on an imaginary straight line (V) connecting the vertical light casting unit and the imaging plane of the component and that interrupts rays of light cast from the vertical light casting unit along the  
10 imaginary straight line onto the component imaging plane.

11. A component placing head as defined in any one of  
claims 1 through 10, further comprising a board image-  
pickup device (41 and 42) capable of capturing an image of  
a specified position on a surface of the circuit board,

15 wherein the board image-pickup device has, as two types of board image-pickup units having different fields of view for image capture and different resolving powers,

a first board image-pickup unit (41) having a narrower field of view and a higher resolving power than a  
20 remainder of the board image-pickup units, and

a second board image-pickup unit (42) having a wider field of view and a lower resolving power than the first board image-pickup unit, and

wherein the control unit is operable to select  
25 either of the first board image-pickup unit and the second

board image-pickup unit of the board image-pickup devices in accordance with an accuracy in placement of components on the circuit board, cause the selected board image-pickup unit to capture the image of the specified position on the surface of the circuit board, and recognizes the specified position on basis of the captured image.

12. A component placing method comprising:

holding a component (1) releasably by each of a plurality of component holding members (11) of a plurality of component holding members arranged in a row;

sequentially capturing images of the components held by the component holding members from a direction along central axes of the component holding members and sequentially capturing images of the components from a direction generally orthogonal to the central axes of the component holding members and to a direction of the arrangement of the component holding members;

recognizing holding postures of the components on the component holding members on basis of the images captured from the direction along the central axes and the images captured from the direction generally orthogonal to the central axes and to the direction of the arrangement; and

placing the components on a circuit board on basis of the recognized holding postures of the components.

13. A component placing method as defined in claim 12,  
wherein holding postures of the components on the  
component holding members with respect to the direction  
generally orthogonal to the central axes can be recognized  
5 on basis of the images of the components captured from the  
direction along the central axes of the component holding  
members, and

wherein holding postures of the components on the  
component holding members with respect to the direction  
10 along the central axes can be recognized on basis of the  
images of the components captured from the direction  
generally orthogonal to the central axes of the component  
holding members and to the direction of the arrangement of  
the component holding members.

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